Properties of oil-bearing sandstones from Paris basin: prospects for CO_2 Geological Storage and Enhanced Oil Recovery

• Aims

The aims of this study are - definition of methodology for description of oil-bearing reservoir in case of **CGS** (CO_2 Geological Storage) and **EOR** (Enhanced Oil Recovery) - updating the BRGM strategic database of prospective storage sites in deep saline aquifers in Paris basin for the future CCS-research projects.

• Methodology

1) Exploration of geological structures and sedimentary basin in projected area
2) Determination of the area that meets the standards for a suitable reservoir
3) Selection of the well bore of the interests in the region, study of existing reports
4) Detailed description of drill core in the range of possible reservoir (very often the available reports in the archives are very old, may not meet the required standards of quality, or be incomplete). The main points are
- core depth control and adjustment. Depth determination of the main stratigraphic units
- stratigraphic, lithological, sedimentary structures description
- characterization of reservoir zones
- determination of the sampling points
5) Sampling (sizes of samples could be different according for equipment of laboratory. If possible, make sampling of all sedimentological types from zones of the reservoir, and from the overlying cap-rocks.
6) Laboratory research: porosity, permeability measurements; thin-section study.
7) Analytical work. Discussion/conclusions.

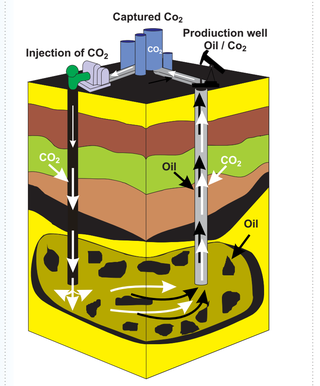


Fig. 1 Simplified model of Enhanced Oil Recovery cycle (Shogenov K.)

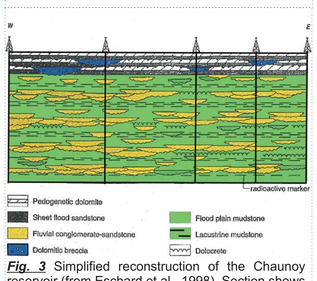


Fig. 3 Simplified reconstruction of the Chaunoy reservoir (from Eschard et al., 1998). Section shows the lenticular structure of the sandstones and conglomerates

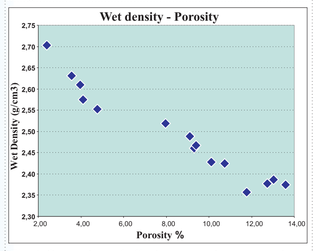


Fig. 5 Correlation of effective porosity values with wet density. Effective porosity of studied samples has clear inverse correlation with wet density

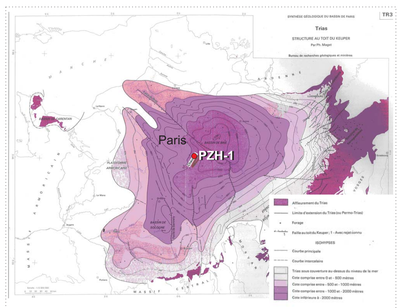


Fig. 2 Structure of the top of the Keuper. Location of Chaunoy formation and PZH-001 well bore (BRGM,1980. Synthese Geologique du bassin de Paris)

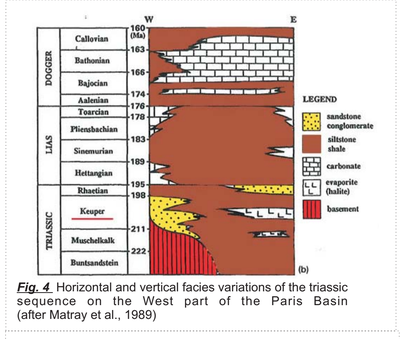


Fig. 4 Horizontal and vertical facies variations of the triassic sequence on the West part of the Paris Basin (after Matray et al., 1989)

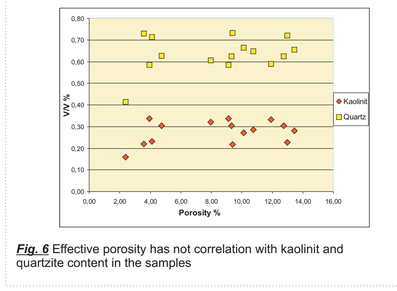


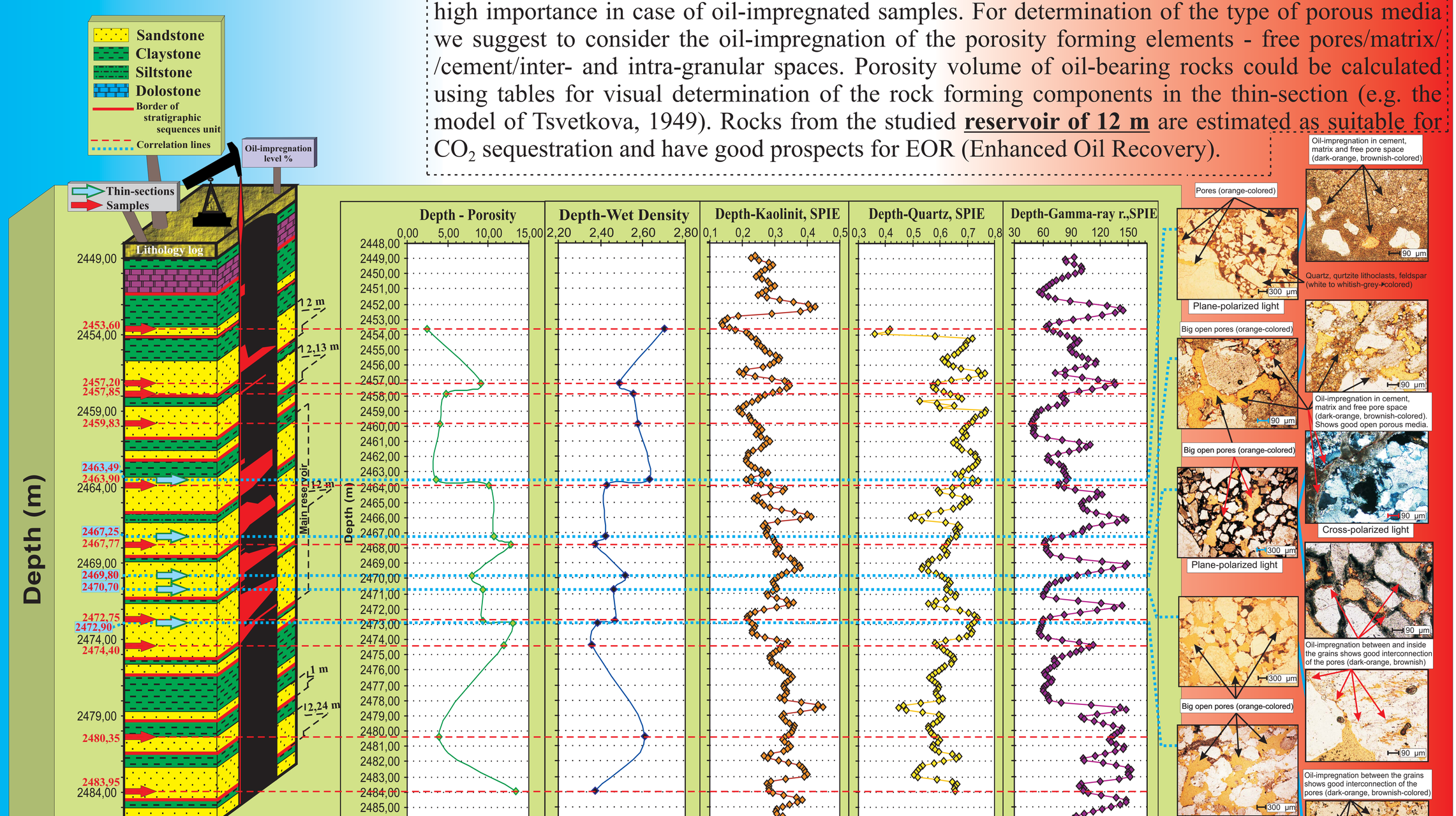
Fig. 6 Effective porosity has not correlation with kaolinit and quartzite content in the samples

• Results

1)/2) The object of the study is **Paris basin**. There are two deep saline aquifers, meeting the requirements for CCS, **Dogger formation in Middle Jurassic and Keuper formations in Upper Triassic.** In the considered area reservoir depth is between **1200-1800 m for the Dogger**, and between **1800-2800 m for the Keuper formations**. The estimations of the storage capacity offered by **Dogger limestones, ca. 13,6 $GtCO_2$; and by Keuper sandstones, ca. 9,5 $GtCO_2$**(Leynet, A. GHGT, 2009). **Salinity** is between **6,5-35 g/l.**
3) The drill core **Pezarches-1 (PZH-1)** owned by TOTAL company was studied. The depth of the studied reservoir (Trias, Keuper, Chaunoy Formation) in range **2449 -2485.4 m** (Fig. 2)
4) Detailed study of the **Chaunoy Formation(36,4 m)** of the PZH1 drill core was done. The depths of the main stratigraphic boundaries units were determined. Detailed model of the studied well bore interval was Built.
5) 15 samples were selected (10 samples for porosity study-1 inch in diameter and 8-10 cm in length and 5 samples for permeability and porosity - 1,5 inches in diameter and 8-10 cm in length).
6) Porosity laboratory measurement experiments were done ("water-porosity" method).Thin-sections were prepared and described (5 samples).
Due to time constraints, the analysis of permeability will be made later.
7) Analytical work is completed. Scientific article is planned to be published.

• Conclusions

The porous media study of the oil-impregnated rocks showed that estimation of their reservoir properties using CO_2 storage criteria (porosity >15%) is not suitable. Using water porosity method all measured effective porosity of samples were less than 15%. However thin-section study using microscope showed higher porosity in the most samples **(>20 %)**. Oil-impregnation in porous rocks did not give possibility to measure real effective porosity. This should be taken into account when making decisions about reservoirs quality. The special chemical reagents should be used to clean samples porous media from oil-impregnation, e.g. Soxhlet extraction (Fabricius, I.L., Nordic Petroleum Technology Series, 2001). Thin-section study and permeability measurements are of the high importance in case of oil-impregnated samples. For determination of the type of porous media we suggest to consider the oil-impregnation of the porosity forming elements - free pores/matrix/ /cement/inter- and intra-granular spaces. Porosity volume of oil-bearing rocks could be calculated using tables for visual determination of the rock forming components in the thin-section (e.g. the model of Tsvetkova, 1949). Rocks from the studied **reservoir of 12 m** are estimated as suitable for CO_2 sequestration and have good prospects for EOR (Enhanced Oil Recovery).



SPIE - data was taken from reports of SPIE company

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